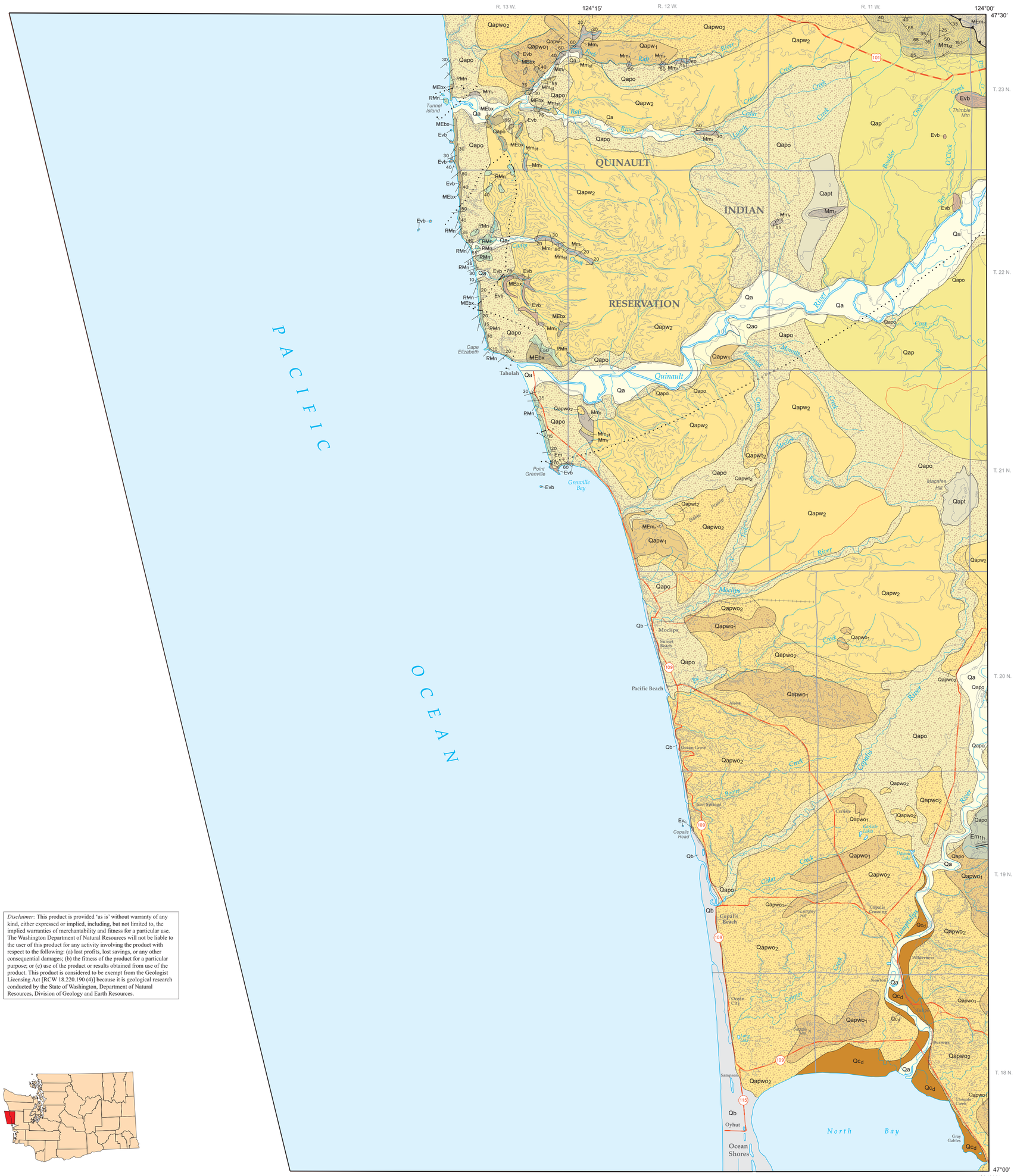
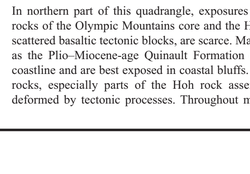
WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands
Division of Geology and Earth Resources
Ron Teissere - State Geologist

WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES
OPEN FILE REPORT 2003-16



Disclaimer: This product is provided 'as is' without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular use. The Washington Department of Natural Resources will not be liable to the user of this product for any activity involving the product with respect to the following: (a) lost profits, lost savings, or any other consequential damages; (b) the fitness of the product for a particular purpose; or (c) use of the product or results obtained from use of the product. This product is considered to be exempt from the Geologist Licensing Act [RCW 18.220.190 (4)] because it is geological research conducted by the State of Washington, Department of Natural Resources, Division of Geology and Earth Resources.



Lambert conformal conic projection
North American Datum of 1927
Base map information from the Washington Department of Natural Resources Geographic Information System
Digital cartography by Anne C. Heinitz, J. Eric Schuster, and Charles G. Caruthers
Editing and production by Karen D. Meyers and Jaretta M. Roloff

SCALE 1:100,000

1 0 1 2 3 4 5 6 7 8 MILES

1 0 1 2 3 4 5 6 7 8 9 10 KILOMETERS

contour interval 120 feet; supplemental contours at 40 and 80 feet

Geologic Map of the Copalis Beach 1:100,000 Quadrangle, Washington

by Robert L. Logan

2003

INTRODUCTION

Methods and Nomenclature

This map was compiled from previously published geologic maps and unpublished thesis maps and supplemented by reconnaissance field mapping and remote sensing studies using aerial photos, digital elevation models, and Side-Looking Airborne Radar (SLAR) images. Bedrock units are represented somewhat schematically on this map because many outcrops, especially in stream channels in the lower part of the Quinault River valley, are so small and ephemeral that they cannot be shown at this scale. Some bedrock polygons were compiled from Tabor and Cady (1978) and Rau (1973, 1986), while others were either modified from the above sources or constructed from field observations. Although Quaternary unit boundaries are commonly diffuse and irregular or obscured by heavy vegetation or weathering, they are depicted by solid lines on this map.

Geologic unit symbols for alpine glacial deposits were chosen to show the relative time of deposition rather than symbolize the unit names assigned by the original mappers. This was done in order to show the time relationship of glacial deposits from one valley to the next and to reduce the need for arbitrary scratch boundaries where glacial deposits from one drainage merge with those from an adjacent drainage, such as on interfluves or beyond the foothills of the mountain range.

Geology

In northern part of this quadrangle, exposures of Tertiary marine sedimentary rocks of the Olympic Mountains core and the Hoh rock assemblage, along with scattered basaltic tectonic blocks, are scarce. Marine sedimentary rocks as young as the Plio–Miocene-age Quinault Formation crop out along the present day coastline and are best exposed in coastal bluffs. Most of the marine sedimentary rocks, especially parts of the Hoh rock assemblage, have been extensively deformed by tectonic processes. Throughout most of this quadrangle, Tertiary rocks are masked by Quaternary-age sediments that were deposited by alpine glacial processes.

The oldest of the Quaternary deposits include deeply weathered reddish-orange gravels that were interpreted by Moore (1965) to be tectonic or nonglacial, although he did allow that they could be of glacial origin. He divided these gravels into an older "moderately and intensely deformed sand and gravel" and a younger "flat lying and slightly deformed sand and gravel". The extent and morphology of these gravels suggest that they are of glacial origin and are probably glacial outwash trains of at least two pre-Wisconsinan glaciations. They are possibly Moore's (1965) Donkey Creek and Humptulips drifts, respectively, although Moore did not make that connection. Two such pre-Wisconsinan drifts were identified in the Queets and Hoh River basins by Thackray (1996). He named the oldest of these the Wolf Creek drift and the youngest the Whale Creek drift.

The moraine of the Whale Creek drift nearly merges beyond the Olympic Mountain foothills with the moraine of the Humptulips drift (Moore, 1965) and is indistinguishable from it. In the lower Quinault River basin, the Humptulips drift is underlain by an older till, probably Moore's Donkey Creek drift. This older till is interpreted here to be equivalent in age to the Wolf Creek drift. So, the Wolf and Donkey Creek drifts and the older deformed gravels of Moore (1965) are shown here as older pre-Wisconsinan units and are so designated with a subscripted number '1' in the unit symbol. These units may correspond in age to the Wedekind Creek formation and part of the Weatherwax formation (Carson, 1970) in the Wynoochee River basin. The Whale Creek and Humptulips drifts and the younger flat-lying gravels of Moore (1965) are shown as younger pre-Wisconsinan units and likely correspond to an ancient unnamed drift in the East and West Fork basins of the Humptulips River (this study), the Mobray drift, and part of the Weatherwax formation (Carson, 1970) in the Wynoochee River basin. These units are indicated by a subscripted number '2' in the unit symbol.

Thackray (1996) mapped an early to middle (or more generally, pre-late) Wisconsinan drift that he called the Lyman Rapids drift. Outwash trains of Lyman Rapids drift are indistinguishable from and merge along a coastal terrace with outwash from Moore's (1965) Chow Chow drift. Moore mapped the Chow Chow drift as the youngest drift in the Quinault basin, but the fact that outwash from this unit merges with that of the pre-late Wisconsinan Lyman Rapids drift suggests that part of the Chow Chow drift is pre-late Wisconsinan, as is shown on this map in units Qap, Qapt, and Qapo. The younger (late Wisconsinan) part of the Chow Chow drift is probably represented by the moraine that impounds Lake Quinault, which is a few miles upstream from the map area, and by a low-elevation inset terrace (unit Qao) along the Quinault River near the center of this map. Unit Qao and the Lake Quinault moraine were deposited at about the same time as the Twin Creeks and Hoh Oxbow drifts (Thackray, 1996), the Grisdale III through VI drifts (Carson, 1970), and an unnamed alpine outwash in the upper Skokomish River basin mapped by Tabor and Cady (1978).

ACKNOWLEDGMENTS

Special thanks are given to Glenn Thackray (Idaho State U.), Bob Carson (Whitman College), and Wendy Gerstel (DGER) for discussions about the Quaternary stratigraphy of the western Olympic Peninsula; Bill Lingley (DGER), Tim Walsh (DGER), Hank Schasse (DGER), Weldon Rau (DGER, retired), and Park Snavely, Jr. (USGS, retired), for mapping and discussions of the Tertiary bedrock; Rowland Tabor (USGS, retired) and Wallace Cady (USGS, retired) for their geologic map of the Olympic Peninsula (Tabor and Cady, 1978); Karen Meyers for editorial review and layout, Jari Roloff for editorial and cartographic support, and Anne Heinitz, Chuck Caruthers, and Eric Schuster for cartography (all DGER); the Quinault Tribe for allowing access to the lower reaches of the Quinault basin; and Connie Manson and Lee Walkling for their library research support. This project was funded in part by the National Cooperative Geologic Mapping Program through Cooperative Agreement No. 98QAG2062.

REFERENCES

Carson, R. J., 1970, Quaternary geology of the south-central Olympic Peninsula, Washington: University of Washington Doctor of Philosophy thesis, 67 p., 4 plates.

Molenaar, Dee; Noble, J. B., 1970, Geology and related ground-water occurrence, southeastern Mason County, Washington: Washington Department of Water Resources Water-Supply Bulletin 29, 145 p., 2 plates.

Moore, J. L., 1965, Surficial geology of the southwestern Olympic Peninsula: University of Washington Master of Science thesis, 63 p., 1 plate.

Rau, W. W., 1973, Geology of the Washington coast between Point Grenville and the Hoh River: Washington Division of Geology and Earth Resources Bulletin 66, 58 p.

Rau, W. W., 1975, Geologic map of the Destruction Island and Taholah quadrangles, Washington: Washington Division of Geology and Earth Resources Geologic Map GM-13, 1 sheet, scale 1:63,360.

Rau, W. W., 1986, Geologic map of the Humptulips quadrangle and adjacent areas, Grays Harbor County, Washington: Washington Division of Geology and Earth Resources Geologic Map GM-33, 1 sheet, scale 62,500.

Tabor, R. W.; Cady, W. M., 1978, Geologic map of the Olympic Peninsula, Washington: U.S. Geological Survey Miscellaneous Investigations Series Map I-994, 2 sheets, scale 1:125,000.

Thackray, G. D., 1996, Glaciation and neotectonic deformation on the western Olympic Peninsula, Washington: University of Washington Doctor of Philosophy thesis, 139 p., 2 plates.

DESCRIPTION OF MAP UNITS

Quaternary Sediments

NONGLACIAL DEPOSITS

Qb — **Beach deposits (Holocene)**—Sand and (or) gravel, with minor shell fragments, deposited along shorelines; includes back-beach dune fields and minor estuarine deposits; clasts are typically well rounded.

Qa — **Alluvium (Holocene)**—Sorted combinations of silt, sand, and gravel deposited in streambeds and alluvial fans; clasts are generally rounded and composed mostly of lithofeldspathic and feldspatholithic sandstone from the core of the Olympic Mountains, with minor amounts of volcanic rock from the periphery of the Olympic Peninsula; may include alpine drift, peat, lacustrine, or landslide deposits; generally lacks discernable weathering; surface is undissected by streams relative to pre-Holocene terrace surfaces.

Qc_d — **Continental sediments (Pleistocene)**—Laminated, blocky, blue-gray silt with interbedded peat; situated stratigraphically between units $Qapwo_1$ and $Qapwo_2$ along the Humptulips River; designated the Damon silt by Moore (1965).

ALPINE GLACIAL DEPOSITS

Qao — **Alpine outwash, late Wisconsinan (Pleistocene)**—Stratified sand and gravel derived from sandstone, slate, and minor basaltic rocks of the Olympic Mountains; contains some silt and clay; clasts are generally more rounded than and lack the facets and striations associated with till clasts; generally not deeply weathered; composes lower stream terraces; terrace surfaces are very poorly dissected by streams; consists of younger outwash of the Chow Chow drift of Moore (1965).

Qap — **Alpine drift, pre-late Wisconsinan (Pleistocene)**—Till and outwash sand and gravel; clasts consist of sandstone, slate, and basalt of the Olympic Mountains core; gray with local orange weathering; may be covered with cream-colored weathered loess; comprises ground moraine of the older part of the Chow Chow drift of Moore (1965), which lies west of Lake Quinault.

Qapt — **Alpine till, pre-late Wisconsinan (Pleistocene)—**Compact, nonstratified, poorly sorted mixture of clay, silt, sand, and gravel with boulders disseminated throughout; clasts consist of sandstone and basalt of Olympic Mountains core and peripheral provenance, respectively, and are commonly striated, faceted, and less rounded than outwash clasts, especially in the sand-size fraction; gray where fresh, mottled yellowish brown to red-brown near the ground surface; may be covered with cream-colored weathered loess; occurs as erosional remnants of the terminal moraine of the older part of Moore's (1965) Chow Chow drift; till is surrounded by outwash trains (unit Qapo).

Qapo — **Alpine outwash, pre-late Wisconsinan (Pleistocene)**—Stratified sand, gravel, and cobbles of mostly sandstone and minor basalt from the Olympic Mountains core and peripheral rocks; includes some peat, silt, clay, and weathered loess; clasts are generally more rounded than clasts in till and lack facets and striations; poorly to moderately sorted; gray to subtle yellow with wispy orange weathering; forms gravel trains that rise at the terminal moraine of the older part of the Chow Chow drift (Moore, 1965) and merge laterally along the coast with and are indistinguishable from the Lyman Rapids outwash of Thackray (1996); both the Chow Chow and Lyman Rapids outwash were deposited along a paleo-shoreline that truncates the till plain of the Humptulips drift of Moore (1965).

$Qapw_2$ — **Alpine drift, younger pre-Wisconsinan (Pleistocene)**—Undifferentiated till and outwash; outwash consists of sand and gravel with laterally discontinuous beds of lacustrine silt and clay; till is locally capped by loess; clasts are composed primarily of litho-feldspathic and feldspatholithic sandstone and basalt; weathered to depths exceeding 12 ft (4 m); red-orange weathering rinds on clasts; ancient surfaces are moderately dissected by streams; includes part of the Whale Creek drift (Thackray, 1996) in the Queets River basin and the Humptulips drift (Moore, 1965) in the Quinault River basin.

$Qapwt_2$ — **Alpine till, younger pre-Wisconsinan (Pleistocene)**—Compact mixture of silt, sand, and gravel; may contain some faceted and striated boulders; deeply weathered to a brownish red color; may also contain minor outwash sand and gravel or loess; mapped where exposures are dominated by till of the Humptulips drift of Moore (1965).

$Qapwo_2$ — **Alpine outwash, younger pre-Wisconsinan (Pleistocene)—**Sand and gravel composed of lithofeldspathic and feldspatholithic sand-stone and basalt derived from the core of the Olympic Mountains; weathered to depths exceeding 12 ft (4 m) with characteristic red-orange weathering rinds; consists mostly of the "flat lying and slightly deformed sand and gravel" of Moore (1965).

$Qapw_1$ — **Alpine drift, older pre-Wisconsinan (Pleistocene)**—Undifferentiated till and outwash; outwash consists of sand and gravel with lenses of lacustrine silt and clay; deep red-orange; clasts thoroughly weathered to depths exceeding 60 ft (20 m); ancient surfaces are highly dissected by streams; includes part of the Wolf Creek drift (Thackray, 1996) in the Queets River basin and pre-Humptulips drift equivalent to the Donkey Creek drift of Moore (1965).

$Qapwo_1$ — **Alpine outwash, older pre-Wisconsinan (Pleistocene)—**Sand and pebble gravel with local beds of coarse gravel and silt; so deeply weathered that clasts can be cut by a knife; gravels are reddish brown and moderately cemented by iron oxide; extensive distribution of deposits scattered along the southern and western flanks of the Olympic Mountains suggest a glacial origin; consists mostly of the "moderately and intensely deformed sand and gravel" of Moore (1965).

Tertiary Sedimentary Rocks

RMn — **Nearshore sedimentary rocks (Pliocene–Miocene)**—Siltstone, sandstone, and conglomerate; fossiliferous; concretionary and carbonaceous; contains flame and ball-and-pillow structures; consists of the Quinault Formation.

Mm_r — **Marine thin-bedded sedimentary rocks (Miocene)**—Thin-bedded (1–20 cm [1–8 in.]) and (or) laminated lithofeldspathic sandstone and siltstone with less abundant claystone, shale, and thick-bedded (>2 ft [>60 cm]) sandstone; minor conglomerate and shale-clast breccia; commonly weathers orange; rhythmically bedded and carbonaceous in part; consists of part of the Hoh rock assemblage (Rau, 1973).

Mm_{st} — **Marine thick-bedded sedimentary rocks (Miocene)**—Thick units of laterally discontinuous, medium- to very coarse-grained, micaceous, feldspatholithic to lithofeldspathic sandstone; minor siltstone-, shale-, and slate-clast breccia, granule conglomerate, and pebble conglomerate; bedding generally thicker than 1 m (3 ft); common platy shale, slate, or siltstone clasts; thick sandstones are separated by thin-bedded (1–12 in. [1–30 cm]) sandstone, siltstone, claystone, and shale; consists of part of the Hoh rock assemblage (Rau, 1973).

MEm_r — **Marine thin-bedded sedimentary rocks (Miocene–Eocene)**—Laminated and (or) thin-bedded (1–20 cm [1–8 in.]), lithofeldspathic and feldspatholithic, micaceous sandstone, siltstone, and slate; thin-bedded units commonly rhythmically bedded; phacoidal structures common; occurs in the northeast corner of the map area.

MEbx — **Breccia (Miocene–Eocene)**—Lenses and angular blocks of sandstone, siltstone, shale, conglomerate, and volcanogenic rocks in a matrix of black shale with scaly cleavage or of intensely sheared sandstone and siltstone; includes diapiric muds, fault breccias, and submarine landslide deposits; includes part of the Hoh rock assemblage (Rau, 1973).

Em — **Marine sedimentary rocks (Eocene)**—Thick- to rhythmically bedded siltstone with thin laminae of fine-grained sandstone; interbedded with Eocene volcanic rocks (unit Evb) at Point Grenville (Rau, 1973, 1975).

Em_{1h} — **Marine sedimentary rocks (Eocene)**—Medium- to coarse-grained 'graywacke' (feldspatholithic or lithofeldspathic(?) sandstone) with minor siltstone interbeds; interpreted to be of pre-Narizian age based on fossil and structural data (Rau, 1986); consists of part of the Hoh rock assemblage (Rau, 1973).

Tertiary Igneous Rocks

Evb — **Basalt (Eocene)**—Altered basalt and (or) basaltic breccia mixed with reddish, green, or gray clasts of argillite; basalts are green or dark gray and contain abundant calcite, chlorite, and other very fine-grained secondary minerals; altered plagioclase phenocrysts persist in some basalts; occurs as isolated blocks that are commonly fault-bounded and surrounded by sedimentary rocks.

Ev_c — **Crescent(?) Formation (middle–lower Eocene)**—Highly altered green-gray volcanic rocks that occur at Copalis Head. Limited exposure at beach level yielded two apparently different basalts. In thin section, one is texturally (subophitic) and mineralogically (plagioclase and augite) similar to Crescent Formation basalt, with amygdules of zeolite; the other is a breccia, the clasts of which consist of ghost plagioclase phenocrysts in a black, fine-grained matrix. The clasts in the breccia are surrounded by calcite. This breccia is similar to rock collected at Fort Canby at the southwest tip of Washington that has been mapped as Crescent Formation basalt. However, the breccia could also be Miocene Grande Ronde Basalt, the westernmost outcrop of which is in Hoquiam at the northwestern end of the Grays Harbor sedimentary basin.

GEOLOGIC SYMBOLS

- Contact—dotted where concealed
- Fault, unknown offset—dotted where concealed
- Normal fault—bar and ball on downthrown side; dotted where concealed
- Thrust fault—sawteeth on upper plate
- Right-lateral strike-slip fault
- Inclined bedding—showing strike and dip
- Vertical bedding—showing strike
- Overturned bedding—showing strike and dip
- Inclined bedding in phacoids in shear zone—showing strike and dip
- Inclined crenulated or warped bedding—showing approximate strike and dip